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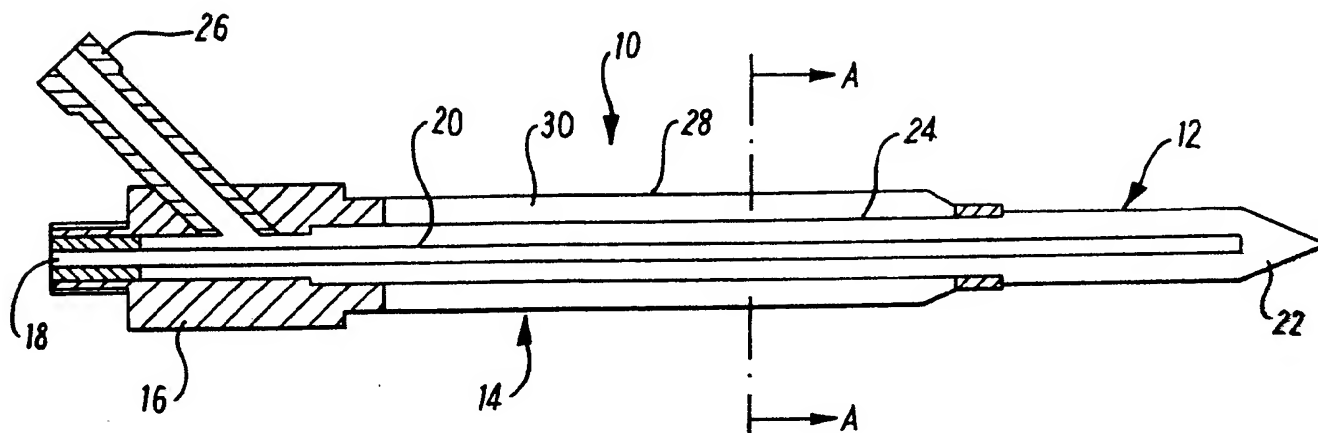
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claims and to be republished in the event of the receipt of
amendments.*

(54) Title: CRYOSURGICAL APPARATUS



(57) Abstract

A cryosurgical probe has an elongate housing with a tip region (12) at one end, a first passageway (20) extending from an inlet for cryogen to the tip region and a second passageway (24) extending from the tip region to an outlet to exhaust. An insulating jacket (28) is provided, which may be air filled or partially evacuated, to insulate at least part of the external surface of the probe housing remote from the tip region in order to ensure that that part of the surface does not become frozen. Damage to tissue outside the area to be treated is thereby minimised, even in cases where the probe is inserted deeply into the tumour.

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Cryosurgical Apparatus

This invention relates to cryosurgical apparatus, and in particular concerns a cryosurgical probe suitable for intra organ penetration.

Cryosurgical probes may be used in the treatment of tumours, for example, using techniques in which a probe tip is inserted to the area of tissue required to be removed and then cooled by the passage therethrough of a cryogen to freeze, and therefore destroy, the tissue surrounding the probe tip. It is desirable to control as carefully as possible a number of parameters, including the speed and extent of the freezing, in order to ensure that tumourous area is completely destroyed with minimum concomitant damage to surrounding healthy tissue.

The present invention seeks to provide apparatus which may be inserted deeply within an organ whilst mitigating or obviating damage of healthy tissue.

According to one aspect of the invention, there is provided a cryosurgical probe comprising an elongate housing having a tip region at one end thereof, a first passageway extending from an inlet to the tip region and

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a second passageway extending from the tip region to an outlet and in communication with the first passageway at the tip region, and insulating means for insulating the external surface of the housing in a region remote from the tip region.

According to another aspect of the invention there is provided cryosurgical apparatus comprising an elongate housing having a closed tip region at one end thereof and inlet means and outlet means for a cryogenic fluid on the housing, a first passageway within the housing in communication with the inlet means for delivery of cryogenic fluid along substantially the entire length of the housing to the tip region to cause cooling of the tip region, a second passageway within the housing for return of cryogenic fluid from the tip region along substantially the entire length of the housing to the outlet means, and means for insulating the external surface of the housing in a region remote from the tip.

Preferably the first and second passageways are defined by two tubes of generally circular cross-section. One tube may have a smaller diameter than the other and may be located internally thereof. In the preferred embodiment, the smaller diameter tube is concentric with the larger diameter tube. The first passageway in the preferred embodiment is defined by the

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internal surface of the smaller tube, and the second passageway in the preferred embodiment is annular in cross-section and bounded by the external surface of the smaller tube and the internal surface of the larger tube.

Preferably the insulating means comprises a gas jacket located around the external surface of the larger tube, to form an outer annular chamber. The chamber may be air filled, or may be partially evacuated.

An embodiment of the invention will now be described by means of illustration only with reference to the accompanying drawings in which:-

Fig. 1 is a longitudinal sectional view through an apparatus of the invention; and

Fig. 2 is a transverse sectional view on line A-A of Fig. 1.

The drawings show a cryosurgical probe having an elongate housing 10 comprising a tip region 12 and a main body portion 14. An inlet 18 is provided at one end 16 of the main body portion 14. The latter is formed substantially along the length thereof by three concentric tubes 20, 24, 28, the respective diameters of the tubes 20, 24, 28 providing an annular passageway 34 defined by the tube 24 around the tube 20, and an

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annular passageway 30 defined by the tube 28 around the tube 24. The tubes 20, 24 extend beyond the tube 28 at the end of the housing remote from the inlet 18 to define the tip region 12, with the tube 24 having a closed end extending beyond the end of the tube 20 to define a space 22 at the end of the tip region 12. The tube 20 is open at the end within the tip region 12 and thereby presents a bore 32 extending from the inlet 18 and communicating with the space 22, the latter also being in communication with the annular passageway 34.

The body 10 of the probe may conveniently be made of stainless steel, whilst the tip region 12 which must have optimum thermal conductivity may be formed from gold plated brass.

In use, the probe tip is inserted into the centre of the tumour or other tissue area required to be removed. A liquid cryogen such as helium or nitrogen is supplied to the inlet 18 and passes along the bore 32 to flood the space 22, and therefore freeze the tip region 12. In causing this cooling effect, cryogen is vapourised. The resulting gas passes along the passageway 34 and is exhausted via the outlet 26.

The annular passageway 30 may be filled or partially filled with air to provide insulation. When air is

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present in the annular passageway 30, some liquefaction occurs during circulation of the cryogen, resulting in a partial vacuum.

The insulating effect of the passageway 30 ensures that the outer surface of the body portion 14 of the probe does not become frozen. Therefore damage to tissue outside the area to be treated is minimised, even in cases where the probe is inserted deeply into the tumour.

The proportion of the probe housing 10 which is covered by the outer insulating tube 28 may be chosen according to specific requirements in any particular case.

It will be appreciated that various modifications may be made without departing from the scope of the invention. The construction and arrangement of the cryogen inlet and outlet, and the arrangement of the delivery and return tubes may be different from that described and shown.

Whilst endeavouring in the foregoing Specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in

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respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

Claims:-

1. A cryosurgical probe comprising an elongate housing having a tip region at one end thereof, a first passageway extending from an inlet to the tip region and a second passageway extending from the tip region to an outlet and in communication with the first passageway at the tip region, and insulating means for insulating the external surface of the housing in a region remote from the tip region.

2. A probe according to Claim 1 wherein the first and second passageways are defined by two tubes of generally circular crosssection.

3. A probe according to Claim 2 wherein the first tube has a smaller diameter than the second and is located concentrically internally thereof.

4. A probe according to any of the preceding Claims wherein the insulating means comprises a gas jacket.

5. A probe according to Claim 4 when dependent on Claim 3 wherein the gas jacket is located around the external surface of the larger tube, to form an outer annular chamber.

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6. A probe according to Claim 4 or Claim 5 wherein the jacket contains air.
7. A probe according to any of Claims 4 to 6 wherein the jacket is partially evacuated.
8. A probe substantially as hereinbefore described with reference to the accompanying drawings.
9. Any novel subject matter or combination including novel subject matter disclosed, whether or not within the scope of or relating to the same invention as any of the preceding Claims.

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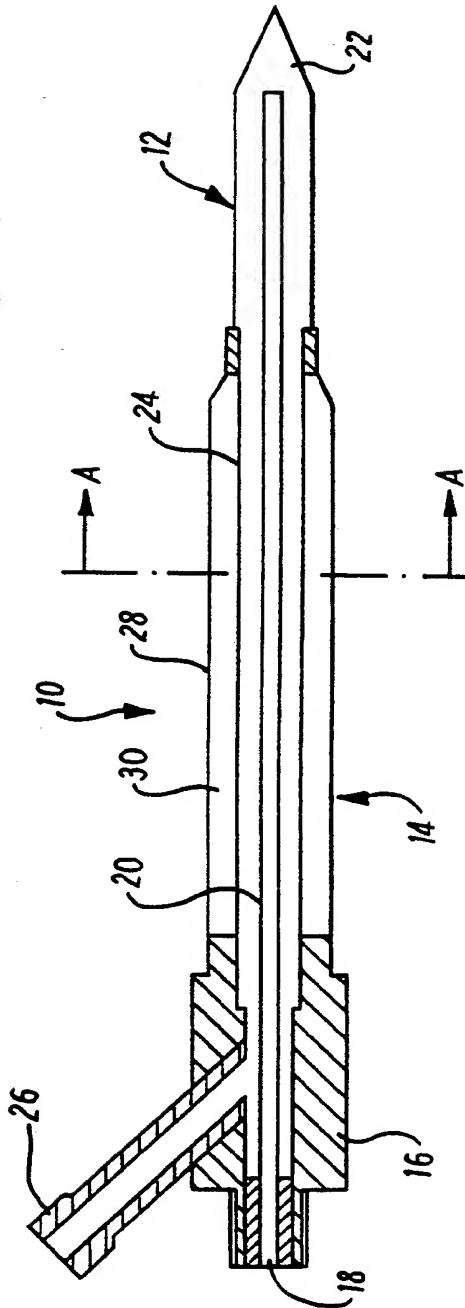


Fig. 1

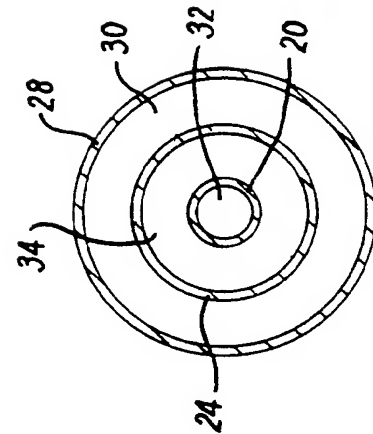


Fig. 2

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A61B 17/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE, A, 2251626 (LINDE AG), 25 April 1974 (25.04.74), page 5 - page 6, figure 1	1-7

A	GB, A, 1103079 (INTERNATIONAL RESEARCH AND DEVELOPMENT COMPANY LIMITED), 14 February 1968 (14.02.68), claim 1	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

25 February 1993

Date of mailing of the international search report

17.03.93

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 92/02028

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 8-9
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Rule 6.2.(a), A claim shall not rely on references to the description or drawings.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

SA 771

INTERNATIONAL SEARCH REPORT

Information on patent family members

29/01/93

International application No.

PCT/GB 92/02028

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 2251626	25/04/74	NONE	
GB-A- 1103079	14/02/68	NONE	